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(54) **A multi-standard adaptive dropout compensator.**

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Description

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to the replacement of missing video in a video signal and, more particularly to a digital dropout compensator with multiple color television standard capability, which selectively replaces missing video data with averaged data from a selected line or lines, or with recirculated data. The replacement data is selected in response to an adaptive decision generated by the location and characteristics of the missing video data.

As known in the art, defects in a television signal produce objectionable picture characteristics when the signal is reproduced as on a television screen. In broadcast television signals these defects arise from RF loss and impose noise on the signals which readily are visible in the television picture. These defects which arise from noise or loss of video RF are referred to in the art as "dropouts".

Since recorded television images corresponding to the television signal contain redundancy from line to line, it is possible to substitute segments or entire lines of the data from adjacent lines in place of the defective segments. To this end, early generations of dropout compensators (DOC) store image information from two lines previous and, when a dropout occurs, insert the previous line of information, or a portion thereof, into the video signal in place of the missing video. However, the process of replacing dropouts by previous line data or by any data is complicated by the characteristics of the signals in composite color television. As well known, in an NTSC color television standard, color television signals include a wideband luminance signal and a phase/amplitude modulated color subcarrier. The latter however, occurs with a 180° phase difference from line to line. This phase difference precludes direct signal substitution between adjacent lines when correcting dropouts because the substituted color information would be incorrectly reproduced. Since the above DOC derives the replacement video from two lines previous, the chroma is in proper phase. However, such video spatially is sufficiently distant from the dropout to have less redundancy whereby the replacement video is a less accurate estimate of the dropout-affected video.

A subsequent generation of DOC's attacked the color phase reversal problem while improving dropout replacement, by substituting a signal which is derived from multiple data samples of a previously stored line. The replacement data is derived by averaging the signal from two data points displaced from the dropout point by approximately ±½ of the color subcarrier period. This provides a signal wherein the color subcarrier is in phase with an adjacent line, and the luminance signal approximates the average of the luminance signal over a color subcarrier period.

Still other DOC systems have been developed which produce a similar result by generating a replacement signal which is the average of four data points, two taken from a following image line and two from a previous image line relative to the image line currently being displayed. This latter DOC system of averaging four data points from adjacent lines, generally employs two serially connected IH delay lines in combination with selected adders to provide the required delays and summations for performing the desired averaging of the four data points. In such a system, the signals first are variously delayed by one-half the color subcarrier period and/or by one color subcarrier period, as generally known in the art, to provide the desired data alignment prior to then summing the results. The summation is then divided by four to produce the replacement signal equal to the average of the four data points. Although this scheme of deriving replacement data from surrounding data points provides more accurate data, it cannot handle extended dropouts of greater than one line. In addition, the scheme requires added circuitry and cannot be adapted to multiple color television standards but has been used primarily either with the NTSC or the PAL standard.

An extension of the above system of averaging multiple surrounding data points employs a complex delay line system which is selectively tapped to provide the desired delays and subsequent additions to perform the averaging function. Such system employs a common delay element whereby all of the tapped signals undergo similar signal processing. In this latter averaging scheme utilizing the common delay element, the summed signal from the succeeding horizontal line may be attenuated with respect to the summed signal from the previous horizontal line, but the attenuation generally is compensated by including gain in the second adder circuit, thus simplifying the circuitry.

The two systems for averaging surrounding data points relative to a dropout in a middle line of a television signal, provide a more accurate replacement signal when compared to the system which merely replaces the dropout with corresponding information from the previous one or two lines. However, the averaging scheme generates noticeable distortion or blurring in pictures having sharp horizontal or angular edges, that is, where there is an intensity change in the vertical direction. To overcome the loss of resolution in the vertical direction, still another averaging scheme selectively records the video such that the originally adjacent samples are not adjacently recorded on the recording media. During reproduction, if a dropout occurs, the difference between

samples in one direction with respect to the dropout sample is computed, and the difference between samples in at least one other direction with respect to the dropout sample also is computed. The signal with the least difference is used to control the direction of data from which the average is computed, which then is used as the replacement data for the dropout sample.

While the various averaging schemes improve the accuracy of replacement data, they are only useful in situations where the dropout is shorter in length then one line of the recorded signal. Such schemes cannot handle extended dropouts of greater than one line duration, which does occur in the field of data recording and reproducing. In addition, since such schemes provide the 1H delay lines prior to the function of chrominance signal inversion to compensate for the differences in chroma phase from line to line, such schemes have been utilized with signals in a single color television standard. That is, such averaging schemes are not readily adaptable to a switchable implementation capable of readily accommodating NTSC, PAL, and SECAM color television standards.

Nonetheless, it is highly desirable in this era of sophisticated, high speed, color television recorders, to provide an associated time base corrector device wherein the dropout compensator provides not only the most highly accurate replacement data for a dropout, but which is also readily switchable between the NTSC, PAL, and SECAM color television standards. To date there are no systems available which are fully digital, and can provide dropout compensation for multi-standard signal systems, while further providing the best possible replacement data for a particular dropout particularly in systems where data is being recorded at non-standard speeds.

SUMMARY OF THE INVENTION

US-A-4251831 describes the replacement of a dropout in a line of a video signal with replacement data taken from the last good line of data before the line containing the dropout.

According to the invention, a method of automatically replacing a dropout in a line of a video signal with replacement data which is taken from another line or combination of other lines is characterised in that a plurality of different lines other than the line of video data in which the said drop-out occurs is examined for dropouts and also made simultaneously available for the selection of data derived from one of said other lines or a combination thereof and the replacement data is adaptively selected in accordance with said examination from the data which is made available for selection.

Preferably the replacement data is selected from data comprising data from a previous line, data from a following line, and spatially averaged data from the lines immediately preceding and following the line in which the said dropout occurs.

A preferred system according to the invention for replacing a dropout in a line of a video signal with replacement data derived from another line or lines comprises means for presenting for selection data from a previous line, data from a following line and data corresponding to an average of lines preceding and following the line in which the said dropout occurs; adaptive logic means for receiving the video signal and for determining the extent and location of the dropout and the best available replacement data; and switch means responsive to the adaptive logic means to select from the said data made available for selection, the best available replacement data commensurate with the extent and location of the dropout.

Preferably the adaptive logic means includes means for detecting the presence of a dropout; and dropout logic means coupled to the detecting means for generating selected adaptive enable decisions corresponding to each of the possible replacement data.

The invention also provides a system for compensating for a dropout in a line of video data, comprising: video signal processing means for providing in relation to said line data from a previous line and a following line; means for simultaneously presenting the video data having the dropout and video data from the previous and following lines; means arranged to examine the data and including a logic circuit for making an adaptive selection of replacement data from the available data; and adaptive switch means for passing, under the control of the said logic circuits, the selected replacement data to an output.

The video signal processing means may include a chroma inverter for receiving the video signal and for generating a luminance signal and an inverted chrominance signal; and a standards switch may be operatively coupled to the chroma inverter and the adaptive switch means to control the adaptive selection in accordance with a desired television standard.

The present invention provides a fully digital adaptive dropout compensator which generates optimum dropout replacement data, and which further is capable of supplying the replacement data for all of the various color television standards, due to the selective arrangement of components forming the dropout compensator. The system is simpler in implementation than the dropout compensators of previous discussion, and provides more accurate replacement data by tailoring the replacement data source to the type of dropout. To this end,

characteristics such as the extent of the dropout and the closest good data available, are detected and an adaptive decision is made, based on the characteristics, to supply replacement data from the most optimum adjacent data available. That is, the invention contemplates replacing dropouts from any of the various available data in selected adjacent lines in response to the adaptive decision. For example, if good video is available in adjacent lines the present adaptive DOC replaces a dropout either by averaging data form the previous line of data, from the following line of data, or by spatially averaging data from both the previous and the following adjacent lines. If video data from multiple adjacent lines is missing, the adaptive logic generates the decision to supply recirculated data from a previous line or lines as the replacement data. Thus the invention provides a multi-standard dropout compensator with multi-standard adaptive logic for detecting which available data source provides the most accurate replacement data for the specific dropout, and which then selects such preferred data to replace the dropout.

The advantageous accuracy, versatility and simplicity of the present adaptive DOC are derived through its improved configuration. To this end, in the absence of a dropout, a first input switch routes the video data through a small delay equivalent to the delay caused by a chroma inverter also in the DOC, and thence through a one-line delay, to derive the output of the dropout compensator. More particularly, the chroma inverter is located at the front of the present adaptive dropout compensator immediately behind the video input switch, with the one line delays located towards the end of the converter downstream of the chroma inverter. This allows the strategic insertion of various digital adders, standard switchers and an adaptive switch, as further described, which allows the use of the same digital circuit paths and thus the same digital circuit components in all standards of operation.

In the presence of a dropout, the adaptive logic of previous mention validates that the previous line and the following line of data are good, whereby the adaptive logic then selects a corresponding position of an adaptive output switch to provide replacement data derived by spatially averaging data from the previous and following lines. If the line previous or the line following have defective or missing data, the adaptive logic selects an adaptive output switch position which provides averaged replacement data from the other good line of data. If all three adjacent lines of data contain dropouts, then the adaptive logic selects a switch position which provides recirculated data from a previous line or lines to replace the dropout on the line currently being displayed.

The system further includes the standards switches of previous mention within the chroma inverter, within a recirculate data loop, and prior to the adaptive output switch, which switches cooperate within the adaptive DOC to provide switchability between the NTSC, PAL and SECAM color television standards in accordance with the invention combination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a block diagram of the adaptive dropout compensator of the invention combination.

FIGURE 2 is a graph depicting the occurrence of dropouts, the available data in adjacent lines and the progress of the dropout replacement through the circuit of FIGURE 1.

FIGURES 3A, 3B, 3C, 3D are a schematic diagram depicting an implementation of the video data path of the circuit of FIGURE 1.

FIGURE 4 is a schematic diagram depicting an implementation of the adaptive dropout logic means and the standards control means of the circuit of FIGURE 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURE 1, a composite color video signal is supplied to a NORMAL position of an input switch 12 via a video data input bus 14, depicted herein as a 9-bit bus by way of example only. A second, DROPOUT position of input switch 12 is coupled to a recirculate data bus 16 (8-bit bus) of a recirculate data loop herein generally designated by numeral 18. The output of the switch 12 is coupled to a chroma inverter circuit 20 via a 9-bit bus 22.

The video data input bus 14 also is coupled to a dropout decoder circuit 24 of an adaptive dropout logic means 26 which provides an adaptive logic decision for selecting the data line or lines which supply the optimum dropout replacement data, as further described below. The dropout decoder circuit 24 supplies a dropout pulse which is indicative of the presence or absence of a dropout, to the video data input switch 12 as well as to an equivalent delay 28, via a dropout line 30.

The input switch 12 supplies the input video data to the equivalent delay 28 and to a chroma bandpass filter 32 via the bus 22 of previous mention. The delay 28 compensates for the delay caused in the chrominance signal path of the chroma bandpass filter 32, and also provides the same delay to the dropout pulse supplied via line 30. The bandpass filter 32 supplies 8-bit chrominance data to a SECAM position of a switch 34 via a

bus 36, and 8-bit chrominance data to a divide-by-2 divider 38 as well as to a NTSC/PAL position of a switch 40, via a bus 42. The bandpass filter 32 may be any of various known digital filters of preferred quality and herein is a five tap digital bandpass filter. The output of the divider 38 is coupled to a SECAM position of the switch 40. The output of the switch 40 is coupled via an 8-bit bus 44 to one input of an adder 46, whose other input is coupled to the small delay 28 via a bus 48. The bus 48 also is coupled to a NTSC/PAL position of the switch 34.

The switch 34 is coupled to a one-line (1H) delay 50, and thence to one input of an adder 52. The output of the adder 46 is coupled to the second input of the adder 52 via an 8-bit bus 54, and the adder 52 is thence coupled to a SECAM position of another switch 56. The bus 54 is coupled to a NTSC/PAL position of a switch 58, whose second, PAL position is coupled to the bus 48 from the equivalent delay 28. The output of switch 58 is coupled to a NTSC/PAL position of the switch 56. The output of switch 56 in turn is coupled to a second 1H delay 60 which is thence coupled back to the DROPOUT position of the input switch 12 via the recirculated data bus 16. As may be seen, the switches 12, 34, 56, 58, the 1H delays 50, 60, the chroma inverter 20, the adder 52 and the bus 16 form various paths of the recirculate data loop 18, which provides various recirculated video data as determined by the presence of a dropout pulse on the dropout line 30, as well as by the particular color television standard selected via the commensurate positions of the various standard switches.

The output of the 1H delay 50 is supplied via a video data bus 62 to one input of an adder 64, and to a NORMAL/PREVIOUS position of a tri-state electronic adaptive switch 66. The bus 54 from the adder 46 is coupled to a NTSC/PAL position of a switch 68, whose other PAL/SECAM position is coupled to the bus 48 of the equivalent delay 28. The output of the switch 68 in turn is coupled to a second input of the adder 64 as well as to a FOLLOWING position of the adaptive switch 66. The output of the adder 64 is fed to a divide-by-2 divider 70, which in turn is coupled to an AVERAGE position of the adaptive switch 66. The adaptive switch 66 provides a video data output signal on a video data output bus 72, wherein the output signal may comprise following line video data, previous/normal line video data, or average video data derived by spatially averaging the following and previous line video data, depending upon the position of the adaptive switch 66. The term "spatially averaging" means that the replacement data for a dropout is spatially correct, that is, is interpolated data that is exactly in phase with the missing data.

The position of the adaptive switch 66 in turn is determined by the adaptive logic means 26 of previous mention in response to the presence of a dropout pulse on the dropout line 30. To this end, the equivalent delay 28 supplies the slightly delayed dropout pulse when present, to a first 1H delay 74 via a dropout line 78 and further depicts the dropout pulse coupled to an input of a dropout logic circuit 78. The output of the 1H delay 74 is a 1H delayed dropout pulse and is coupled to an 1H delay 80 and to an input of the dropout logic circuit 76, via a line 82. The output of the 1H delay 80 is a 2H delayed dropout pulse and is coupled to another input of the dropout logic circuit 76 via a line 84. The logic circuit 76 supplies selected adaptive decisions via respective enable lines 86, 88, 90. For example, the logic circuit 76 may supply a FOLLOWING ENABLE, a NORMAL/PREVIOUS ENABLE or an AVERAGE ENABLE logic decision, which is fed to the adaptive switch means 66 to select the corresponding switch position.

FIGURE 1 depicts how the dropout pulse from the dropout decoder 24 is delayed by one line increments to remain in time without dropout data derived via the adaptive DOC. The truth table included below depicts the logic conditions corresponding to the delayed dropout pulse, which are supplied via the dropout logic circuit 76 on enable lines 86-90 coupled to the adaptive switch 66, to select the switch positions.

ØH	1H	2H	
Line 78	Line 82	Line 84	swit 66 pos'n
0	0	0	NORMAL/PREVIOUS
0	0	1	NORMAL/PREVIOUS
0	1	0	NORMAL/PREVIOUS
0	1	1	NORMAL/PREVIOUS
1	0	0	FOLLOWING
1	0	1	AVERAGE
1	1	0	NORMAL/PREVIOUS
1	1	1	NORMAL/PREVIOUS

0 - Dropout

1 - No Dropout

The operation of the adaptive logic means 26 for selection of the positions of the adaptive switch 66, is further illustrated in FIGURE 2 taken together with the truth table above. The logic tracks different points, herein labeled INPUT, A, B, C and OUTPUT, corresponding to the points shown along the circuit of FIGURE 1. By way of example only, three different dropout cases are considered, herein termed case 1, case 2 and case 3, each of which is less than one line in length (10 microseconds, for example) and in each case there is a lightly different overlap between the dropout and data in adjacent lines. Data corresponding to each of the cases appears at the output data bus 72 one line later than the input data at the input data bus 14. Due to the different overlap conditions of this example, six different replacement data results are obtained via action of the adaptive logic means 26 and adaptive switch 66. Three of the results provide averaged line data signals, two of the results provide previous line data signals and one result provides a following data signal, at the output data bus 72. The graph is generally self-explanatory, wherein the lines from which replacement data is derived are identified by line numbers appearing above the segments shown at points A, B, C and OUTPUT of the graph.

More particularly, by way of example only, in case 1, line 3 has a dropout and lines 2 and 4 have good data vertically adjacent. Thus the replacement data at the output bus 72 is shown one line later and is derived by spatially averaging data samples from previous line 2 and following line 4 with the adaptive switch 66 in the AVERAGE position. In case 2, line 3 has a dropout, line 2 has good data but line 4 also has a dropout. Thus the replacement data at the output bus 72 appears one line later and is derived from the previous line 2, with the adaptive switch 66 in the NORMAL/PREVIOUS position. In case 2, line 4 has a dropout, while both lines 3 and 5 also have dropouts in vertically adjacent locations. Thus the replacement data at the output bus 72 appears one line later and is derived from recirculated data taken from line 2 and stored in the recirculate data loop 18. The adaptive switch 66 is in the NORMAL/PREVIOUS position. In case 2, line 5 has a dropout, lines 3 and 4 have dropouts vertically adjacent, but line 6 has good data. Thus the replacement data that appears at the output bus 72 is derived from the following line 6 with the adaptive switch in the FOLLOWING position.

Accordingly, it may be seen that the adaptive logic means 26 detects the availability of good data in the vertically adjacent lines relative to a dropout and, based on the closest good data available, generates an adaptive decision corresponding to the best available replacement data as reflected in the truth table above. The decision then selects the corresponding position in the adaptive switch 66 via the enable lines 86-90. If extended dropouts greater than one line are experiences, than the adaptive switch 66 supplies recirculated data as the replacement data via the NORMAL/PREVIOUS position, as previously discussed.

As may be seen, FIGURES 3A,3B,3C, 3D illustrate an implementation of the video data processing circuitry of FIGURE 1 wherein like components also are similarly numbered and readily identified by comparison with the block diagram of FIGURE 1. Likewise, FIGURE 4 illustrates an implementation of the adaptive logic means 26 and the standards control means 92 of FIGURE 1, wherein like components are similarly numbered.

Referring to FIGURES 3, 4 as well as FIGURE 1, the operation of the adaptive dropout compensator generally is described herein for an NTSC color television standard wherein accordingly, the standards switches 34, 40, 56, 58 and 68 are placed in the NTSC/PAL position. The standard used is selected by means of a standards control means 92 illustrated in FIGURES 1 and 4 as a latch 94 for receiving control data via an 8-bit bus 96. The control data is in the form of 8-bit digital words supplied by system control (not shown) and determined,

for example, by microprocessor input corresponding to the desired standard. The latch 94 supplies a pair of standard bits via lines 98 to a standards decoder 100. The decoder 100 includes a plurality of logic gates 101 (FIGURE 4) for generating a corresponding logic level on each of various standards control lines 102, which select the positions of the various switches 34, 40, 56, 58 and 68 to select the desired standard. The standards decoder 100 also supplies a second set of logic levels corresponding to the respective color standards to respective 1H delays 50, 60, 74 and 80 via control lines 104. A line 105 also supplies a logic level corresponding to a 525 or 625 line scan raster which is fed to the various 1H delays 50, 60, 78, 80 to implement the corresponding raster. A truth table 99 (FIGURE 4) shown near the decoder 100 explains the binary logic supplied via lines 98 and thus the logic decisions supplied via the control lines 102, 104, 105.

In the NTSC standard, the normal data signal or the recirculated data is routed to the chroma inverter circuit 20, whereby the chrominance signal (-2C) is selected via the switch 40 and is applied to the adder 46 together with the normal data signal (Y + C) on the bus 48 from the equivalent delay 28. The resultant summed signal (Y-C) is re-clocked by a register 106 (FIGURE 3C) and an exclusive OR-gate 107, (FIGURE 3A), which together function as an overload detector using 2's complement arithmetic and with a selector to set the value equal to the maximum or minimum 2's complement value; where 7F equals maximum and 80 equals minimum. The register 106 produces the signal (Y-C) on bus 54. After chroma inversion, the signal is routed through the switch 58, a short delay 108 and thence to the switch 56. The short delay 108 includes a register which allows the signal to be re-clocked. The signal is recirculated back to the input data switch 12 via the 1H delay 60, and thus is available as recirculated data with 1H delay.

A re-clocking overload detector 116 (FIGURE 3B) is coupled to the adder 52 and uses 2's complement arithmetic with an exclusive OR-gate 118 to detect the overload as described for detector 106.

The chroma inverter circuit 20 also routes the recirculated data or the normal video data to the 1H delay 50 and thence to the NORMAL/PREVIOUS position of the adaptive switch 66 via the bus 62. The adder 46 supplies the chrominance inverted signal (Y-C) to the FOLLOWING position of the adaptive switch 66 via the bus 54 and switch 68. Spatial averaging is done via the adder 64 which sums chrominance inverted previous line data and following line data and divides by two at the input thereof by bit shifting. The spatially averaged data appears at the AVERAGE position of the adaptive switch 66.

In normal NTSC operation, when there is no dropout, the input data switch 12 is placed in the NORMAL position by the logic level on dropout line 30 (FIGURES 1,3A), whereby the input video data on bus 14 is fed through the equivalent delay 28 and 1H delay 50, to the adaptive switch 66. Since there is no dropout, the adaptive logic means 26 supplies the NORMAL/PREVIOUS ENABLE logic decision via the line 88 to place the adaptive switch in the NORMAL/PREVIOUS position. Thus, the input video data appears on the video data output bus 72 one line after it is fed to the input bus 14. Simultaneously, the good line of data also is fed to the 1H delay 60 via the chroma inverter 20 and thus is stored in the recirculated data loop 18 with inverted chrominance.

In the event of a dropout, for example in the next line of data, the input data switch 12 is placed in the DROPOUT position via the dropout pulse on dropout line 30. The output of switch 12, i.e., bus 22, has good recirculated data from the previous line, which data further has the correct chrominance phase and thus is available for use at the output of the adaptive dropout compensator. The phase is correct because of the presence of the chroma inverter in the recirculate data path, which passes the luminance signal (Y) and inverts the chrominance signal (Y-C) which is alternating in phase on each line in NTSC. Since the normal delay from input to output of the compensator is one line, during a dropout the adaptive switch 66 may select the recirculated data from two lines previous (since there is a one line delay 50 from input to output and a one line delay 60 in the recirculate data path) or, may select the chrominance inverted following line of data at the data bus 22 which has no delay and therefore is one line in advance of the normal data signal. In addition, the adaptive logic means 26 (FIGURE 4) may select the AVERAGE position on the adaptive switch 66 to thereby supply the average data signal derived by spatially averaging the following and previous data signals. Thus, the adaptive logic means 26 determines the best possible data available to replace the dropout and selects the corresponding position on the adaptive switch 66 in response to the corresponding FOLLOWING ENABLE, NORMAL/PREVIOUS ENABLE or AVERAGE ENABLE logic decisions supplied by the adaptive logic means 26 via respective enable lines 86, 88 or 90.

As further shown in FIGURE 4, the dropout pulse is detected in the dropout decoder circuit 24 which supplies the corresponding logic level to the input data switch 12 via line 30, and to a shift register 112 of the equivalent delay 28 (FIGURE 3C). The dropout pulse then is fed to the dropout logic circuit 76 (FIGURES 1,4) and to 1H delays 74, 80 of FIGURE 1 to provide the adaptive logic decisions.

In a PAL system, the present adaptive DOC operates essentially as described above for a NTSC system with the selection of the NTSC/PAL position on switches 34, 40 and 56, and with switches 58, 68 toggling between the PAL positions, as directed by the standards control means 92 (FIGURES 1,4). To process PAL sig-

nals, the adaptive dropout compensator uses a technique generally known in the art as "PAL modifier", to first convert the PAL (or PAL-M) signal. The PAL modifier technique is based on the signal characteristics of the PAL system, wherein the V axis of U and V chrominance samples phase alternate from line to line, with the subcarrier advancing by 90 degrees each line and with 4Fsc sampling on the burst zero degree phase crossing axis. Since the 4Fsc sampling phase aligns with burst zero phase crossing it is shifted 45 degrees from the U and V axes, whereby each 4Fsc sample contains U and V information. Thus chrominance samples will have identical, or opposite, phase from one line to the next depending on the 2Fsc period. The true 2Fsc clock appears as an odd number of cycles per horizontal line and alternates in phase from line to line. Thus any line of data can be derived from any previous line of data by inverting the chrominance phase of the sample on the previous line whenever the 2Fsc clock is detected as a high logic level, and by not inverting the phase when the 2Fsc clock is detected as low.

It follows that phase inversion is provided by toggling the switches 58 and 68 (FIGURES 1 and 3D) between their PAL positions at a 2Fsc rate via the respective line 102 when in a PAL or PAL-M standard. The 2Fsc clock is supplied via a line 103 (FIGURE 3C) and a plurality of inverting gates 110 which also receive the NTSC, PAL and SECAM logic from the standards decoder circuit 100 and a H/2 system timing signal. Luminance (Y) remains the same on either side of the switches but the chrominance phase inverts from (+C) to (-C). Thus, the switches 58, 68 provide the luminance and alternating chrominance signals from the signals (Y-C) on bus 54 and (Y + C) on the bus 48. The 1H delays 50 and 60 herein are clocked at 2 Fsc and are multiplexed into two parallel paths to reduce the speed at which their memories (not shown) have to operate. Because there is an even number of 2 Fsc cycles per line in NTSC and an odd number of cycles in PAL, an odd/even trim of one 4 Fsc cycle is placed in each of the 1H delay paths via the short delay 108 (FIGURE 3B) and a short delay 114 in the equivalent delay 28 (FIGURE 3C). The short delays are multiplexer/registers with four 8-bit data latches arranged in series to select outputs of from one to four small delays. In all other respects the video and chrominance paths and the operation of the present adaptive dropout compensator corresponds to when operating in the NTSC standard.

In the SECAM standard, the standards control means 92 directs the switches 34, 40, 56 and 68 to the SECAM positions, whereby missing data is replaced by a whole line of recirculated data from the recirculate data loop 18, rather than by partial line replacement. This is required in SECAM since its frequency modulated chrominance signal cannot be interrupted during a data line, and thus the decoded dropout signal is formed in continuous line blocks. In the absence of a dropout, the normal signal path is via the NORMAL position of the input data switch 12, the equivalent delay 28, the switch 68 and the FOLLOWING position of the adaptive switch 66. During a dropout, video data is recirculated with one line of delay for the luminance signal and two lines of delay for the chrominance signal to provide proper chrominance line type. This is necessary, since there are two line types in the SECAM standard, one with R-Y encoded FM and one with B-Y encoded FM, which alternate every other line, as is generally known in the art.

To this end, to separate chrominance and luminance, the bandpass filter 32 provides a chrominance signal on bus 36 and an inverted chrominance signal on bus 44. The non-inverted chrominance signal (C) is delayed one line by 1 H delay 50, while the inverted chrominance signal (-C) is subtracted from the composite video signal (Y + C) via the adder 46 to obtain the luminance signal (Y) on bus 54. The luminance signal (Y) and the 1H delayed chrominance signal (C) are added together via the adder 52, and the composite video signal (Y + C) is supplied back to the DROPOUT position of the input data switch 12 via the switch 56, the 1H delay 60 and the recirculate data bus 16. More particularly, chrominance data is routed to the 1H delay 50 by enabling the switch 34 with SECAM(+) from the respective line 102 of the standards decoder means 100. The output from delay 50 carried delayed chrominance which is added to luminance in adder 52. The re-clocking overload detector 116 of previous mention (FIGURE 3B) is coupled to the adder 52 and supplies the composite video signal (Y + C) to the 1H delay 60.

The SECAM data signal of 1H delayed luminance and 2H delayed chrominance is supplied via data bus 48 and switch 68 to the FOLLOWING position of the adaptive switch 66, as directed by the adaptive logic means 26.

Nominal delay through the present adaptive DOC is one line in NTSC and PAL systems, but only a few clock cycles in SECAM. All functions in the system operate at 4 Fsc and use 2's complement arithmetic. To convert 2's complement at the input, the most significant bit (MSB) of the input video data is inverted prior to the input data switch 12. To convert back to unsigned binary numbers at the output of the adaptive DOC, the MSB at the output bus 72 is inverted. The latter configuration is further shown in the FIGURE 3D. Although 9-bit resolution is maintained through the compensator for normal signal data, only the eight MSB's are used for dropout data.

The dropout compensation is performed in digital form on video data which has previously been time base corrected. The dropouts are identified by a binary word consisting of, for example, all zero bits which are pre-

viously inserted in the video data stream and which thus are supplied to the dropout decoder circuit 24 via input video bus 14 (FIGURE 4). The all-zero word is detected and then replaced with the correctly phased digital replacement data by the present adaptive DOC. Since any time base errors have been removed and since chroma inversion is provided prior to the 1H delays 50, 60, the DOC is adapted to dropout compensation in all standards, as well as in all modes of operation, including slow motion and shuttle speeds, via the corresponding selection of the standards switches positions, as previously discussed.

Although the present adaptive DOC generally has been described relative to missing data in video recovered from a recording media such as magnetic tape, it may be used for correcting impairments in any signal wherein the impairments can be detected, and wherein there is a certain redundancy in the signal content.

Claims

1. A system performing a method of automatically replacing a dropout in a line of input video data constituted by samples of a composite color television signal, which includes a chrominance component in the form of a modulated color subcarrier signal, with replacement data which is taken from another line or combination of other lines of the composite colour television signal, characterised by:
a dropout decoder (24) coupled to receive the input video data and to produce a dropout pulse indicative of the presence of a dropout in the video data;
adaptive logic means (26) coupled to the decoder such that the said line of video data in which the dropout occurs and a plurality of different lines other than the said line of video data in which the said dropout occurs are examined for dropouts;
video signal processing means (20) including a plurality of signal paths, of which one includes a chroma inverter (32) and another path includes a delay (28) equivalent to delay in the chroma inverter, the paths extending to a data recirculation loop (16) and also to an adaptive switch (66) at which the said plurality of lines is made simultaneously available for the selection of data derived from one of said other lines or a combination thereof and the replacement data is adaptively selected in accordance with said examination from the data which is made available for selection, the data made available for selection being composite video data having a chroma phase which is the same as the missing data which is represented by the dropout; and
a switch (12) which supplies the input video data to said video processing means (20) when there is no dropout in the input video data and supplies to the video processing means a signal from the data recirculation loop (16) in the presence of a dropout in the input video data.

2. A system according to claim 1 in which the video signal processing means (20) includes various switches, adders and delays downstream of the inverter such that the replacement data is selected from composite video data comprising data from a previous line, data from a following line, and spatially averaged data from the lines immediately preceding and following the line in which the said dropout occurs and in accordance with any one of a multiplicity of television standards, the various switches downstream of the chroma inverter and the adaptive switch being coupled for control by a standards decoder (100), so that the data presented for selection is in accordance with a selected television standard.

3. A system according to claim 1 or claim 2 in which the adaptive selection is represented by binary words which control a switching means for the selection of data made simultaneously available from the said lines.

4. A system according to any of claims 1 to 3 in which the selection is made in accordance with the relationship of the dropout to vertically located data in adjacent lines of the video signal.

5. A system for replacing a dropout in a line of an input composite color video signal with replacement data derived from another line or lines, characterised by,
video signal processing means (20) including a chroma inverter (32) and means (62,64,68) for presenting for selection data from a previous line, data from a following line and data corresponding to an average of lines preceding and following the line in which the said dropout occurs, said data being composite video data having a chroma phase which is the same as the missing data represented by the dropout, said video signal processing means comprising a data recirculation loop for supplying delayed and recirculated data;
adaptive logic means (24,26) for receiving the video signal and for determining the extent and location of the dropout and the best available replacement data;

switch means (66) responsive to the adaptive logic means to select from the said data made available for selection, the best available composite video replacement data commensurate with the extent and location of the dropout; and

an input switch (12) which supplies the input video signal to said video signal processing means (20) when there is no dropout in the input video signal and supplies to the video signal processing means delayed and recirculated data from the data recirculation loop during a dropout in the input video signal.

6. A system according to claim 5 wherein the adaptive logic means includes means (24) for detecting the presence of a dropout; and dropout logic means (26) coupled to the detecting means for generating selected adaptive enable decisions corresponding to each of the possible replacement data.

7. A system according to claim 6 wherein the dropout logic means (26) includes means for generating binary words indicative of the adaptive enable decisions.

8. A system according to claim 7 wherein the dropout logic means (26) simultaneously examines a current video line and the lines immediately preceding and following the current line in response to the detecting means to determine the extent and location of a dropout in the video signal.

9. A system for compensating for missing data represented by a dropout in a line of video data, constituted by data samples of a composite color television signal, characterised by,

video signal processing means (20,32,28) for providing in relation to said line data from a previous line and a following line, and including means for simultaneously presenting a current line of the video data having the dropout and composite video data from the previous and following lines and including a data recirculation loop (16) for supplying delayed and recirculated data back to the input of the video signal processing means;

means (24,26) arranged to examine the video data for dropouts and including a logic circuit (76) for making an adaptive selection of the best replacement composite video data from the available data; and

adaptive switch means (66) for receiving the video data from said current line and the said previous and following lines and for passing to an output, under the control of the said logic circuit, either the current line in the absence of a dropout or the selected replacement data during the occurrence of the dropout, the replacement composite video data having a chroma phase which is the same as the chroma phase of the missing data.

10. A system according to claim 9 in which the video signal processing means includes a chroma inverter (20), comprising a chroma band-pass filter (32) and a first standards switch (40), for receiving the video signal and for generating a luminance signal and an inverted chrominance signal; a standards decoder (100) is operatively coupled to the chroma inverter and the first standards switch and a second standards switch (68) to control the adaptive selection in accordance with a desired television standard.

11. A system according to claim 9 or claim 10 in which the processing means further comprises a delay (50) for providing a video signal delayed by one line with respect to a current video signal, and means (70) for spatially averaging the said current video signal and a recirculated video signal from the data loop; and the adaptive switch means (66) is arranged to pass selectively an output video signal from the chroma inverter (20) and the averaging means (70) in accordance with the adaptive selection made by the logic circuit (76).

12. A system according to any of claims 9 to 11 characterised by means (24) for generating a dropout pulse which indicates the presence of a dropout, and means (74,80) for providing dropout pulses delayed by one line and two lines respectively, the logic circuit (76) including logic gates arranged to examine three consecutive lines for the presence of the said dropout pulses.

13. A system according to claim 11 in which the switch means (66) is arranged to select an output signal from the current video signal, the recirculated video signal and the spatially averaged video signal.

14. A system according to claim 9 and characterised by a chroma inverter (20); a first, one line delay (50) coupled to the chroma inverter; a first switch (56) operatively coupled to the chroma inverter and to the first delay; a second, one line delay (60) defining said data recirculation loop coupled from the first switch back to the chroma inverter; and a second switch (68) coupled to the chroma inverter; the adaptive switch means (66) being coupled to the outputs of the chroma inverter, the second switch and the first delay.

15. A system according to claim 14, further including a third switch (58) coupling the chroma inverter to the first switch (56); and a standards control (96-100) for supplying a switch control signal to the said first, second and third switches.

16. A system according to claim 14 or claim 15 further including data averaging means (64,70) coupled to the first delay means (50) and to the second switch (68) and disposed to supply spatially averaged data to the adaptive switch means (66).

Patentansprüche

1. System zur Durchführung eines Verfahrens zum automatischen Ersetzen eines Ausfalls in einer Zeile von Eingangsvideodaten, die durch Abtastungen eines eine Chrominanzkomponente in Form eines modulierten Farbhilfsträgersignals enthaltenden zusammengesetzten Farbfernsehsignals gebildet sind, durch Ersatzdaten, welche aus einer anderen Zeile oder einer Kombination anderer Zeilen des zusammengesetzten Farbfernsehsignals entnommen werden, **gekennzeichnet durch**:
einen Ausfalldecoder (24), der zum Empfang der Eingangsvideodaten und zur Erzeugung eines das Vorhandensein eines Ausfalls in den Videodaten anzeigenden Ausfallimpulses gekoppelt ist;
adaptive Logikmittel (26), die derart an den Decoder angekoppelt sind, daß die Videozeile, in welcher der Ausfall auftritt, und eine Vielzahl von von dieser den Ausfall enthaltenden Videozeile verschiedenen Zeilen auf Ausfälle untersucht werden;
Videosignal-Verarbeitungsmittel (20) mit einer Vielzahl von Signalwegen, von denen einer einen Chrominanzinverter (32) und ein weiterer eine der Verzögerung im Chrominanzinverter äquivalente Verzögerung (28) enthält, die Wege zu einer Datenrückführungsschleife (16) und weiterhin zu einem adaptiven Schalter (66) verlaufen, an denen die Vielzahl von Zeilen gleichzeitig zur Auswahl von aus den anderen Zeilen oder einer Kombination von diesen abgeleiteten Daten verfügbar sind und die Ersatzdaten in Abhängigkeit von der Untersuchung der zur Auswahl verfügbaren Daten adaptiven Zeilen ausgewählt werden, und die zur Auswahl verfügbaren Daten zusammengesetzte Videodaten mit einer Chrominanzphase sind, welche gleich der der durch den Auswahl repräsentierten fehlenden Daten ist; und
einen Schalter (12), der die Eingangsvideodaten an die Videoprozessormittel (20) abgibt, wenn kein Ausfall in den Eingangsvideodaten vorhanden ist, und den Videoprozessormitteln bei Vorhandensein eines Ausfalls in den Eingangsvideodaten ein Signal von der Datenrückführungsschleife (16) zuführt.

2. System nach Anspruch 1, in dem die Videosignal-Verarbeitungsmittel (20) hinter dem Inverter Schalter, Addierer und Verzögerungen enthalten, so daß die Ersatzdaten aus zusammengesetzten Videodaten, welche Daten aus einer vorhergehenden Zeile, Daten aus einer folgenden Zeile sowie räumlich gemittelte Daten aus den Zeilen umfassen, welche den Zeilen der Zeile, in der der Ausfall auftritt, unmittelbar vorhergehen und folgen, sowie in Abhängigkeit einer Vielzahl von Fernsehnormen ausgewählt werden, und die Schalter hinter dem Chromainverter und der adaptive Schalter derart zur Steuerung durch einen Normdecoder (100) gekoppelt sind, daß die zur Auswahl bereitgestellten Daten in Übereinstimmung mit einer ausgewählten Fernsehnorm stehen.

3. System nach Anspruch 1 oder 2, in dem die adaptive Auswahl durch Binärwörter repräsentiert ist, welche Schaltermittel zur Auswahl von Daten steuern, die gleichzeitig aus den Zeilen zur Verfügung stehen.

4. System nach den Ansprüchen 1 bis 3, in dem die Auswahl als Funktion des Zusammenhangs des Ausfalls und vertikal angeordneten Daten in benachbarten Videosignalzeilen durchgeführt wird.

5. System zum Ersatz eines Ausfalls in einer Zeile eines zusammengesetzten Eingangsfarbvideosignals durch Ersatzdaten, die aus einer anderen Zeile oder anderen Zeilen abgeleitet sind,
gekennzeichnet durch
Videosignal-Verarbeitungsmittel (20), welche einen Chromainverter (32) und Mittel (62, 64, 68) zur Bereitstellung von Daten für die Auswahl aus einer vorhergehenden Zeile, Daten aus einer folgenden Zeile sowie Daten entsprechend einem Mittelwert von der den Ausfall enthaltenden Zeile vorhergehenden und folgenden Zeilen enthalten, wobei die Daten zusammengesetzte Videodaten sind, deren Phase gleich der durch den Ausfall repräsentierten fehlenden Daten ist, die Videosignal-Verarbeitungsmittel eine Datenrückführungsschleife zur Abgabe verzögerter und rückgeführter Daten umfassen;

adaptive Logikmittel (24, 26) zur Aufnahme des Videosignals sowie zur Bestimmung des Ausmaßes und der Lage des Ausfalls und der besten verfügbaren Ersatzdaten;
von den adaptiven Logikmitteln angesteuerte Schaltermittel (66) zur Auswahl der mit dem Ausmaß und der Lage des Ausfalls übereinstimmenden besten verfügbaren zusammengesetzten Videoersatzdaten aus den zur Auswahl verfügbaren Daten;
und einen Eingangsschalter (12), der das Eingangsvideosignal an die Signalverarbeitungsmittel (20) abgibt, wenn kein Ausfall im Eingangsvideosignal vorhanden ist, und der verzögerte und rückgeführte Daten von der Datenverarbeitungsschleife während eines Ausfalls im Eingangsvideosignal an die Videosignal-Verarbeitungsmittel abgibt.

6. System nach Anspruch 5, in dem die adaptiven Logikmittel Mittel (24) zur Detektierung des Vorhandenseins eines Ausfalls und an die Detektormittel angekoppelte Ausfallogikmittel (26) zur Erzeugung ausgewählter adaptiver Freigabeentscheidungen entsprechend den möglichen Ersatzdaten enthält.

7. System nach Anspruch 6, in dem die Ausfallogikmittel (26) Mittel zur Erzeugung von die adaptiven Freigabeentscheidungen anzeigenden Binärwörtern enthält.

8. System nach Anspruch 7, in dem die Ausfallogikmittel (26) gleichzeitig eine laufende Videozeile und die der laufenden Videozeile unmittelbar vorhergehenden und folgenden Zeilen in Abhängigkeit von den Detektormitteln zur Bestimmung des Ausmaßes und der Lage eines Ausfalls im Videosignal untersuchen.

9. System zur Kompensation von durch einen Ausfall in einer Zeile von Videosignalen repräsentierten Daten, wobei die Videodaten durch Abtastwerte eines zusammengesetzten Farbfernsehsignals repräsentiert sind,
gekennzeichnet durch
Videosignal-Verarbeitungsmittel (20, 32, 28) zur Abgabe von Daten aus einer vorhergehenden Zeile und einer folgenden Zeile in Bezug auf die Zeile mit Mitteln zur gleichzeitigen Bereitstellung einer den Ausfall enthaltenden laufenden Zeile der Videodaten und zusammengesetzten Videodaten aus den vorhergehenden und folgenden Zeilen und mit einer Datenrückführungsschleife (16) zur Rückführung verzögerter und rückgeführter Daten auf den Eingang der Videosignal-Verarbeitungsmittel;
Mittel (24, 26) zur Untersuchung der Videodaten hinsichtlich Ausfällen mit einer Logikschaltung (26) zur Durchführung einer adaptiven Auswahl der besten zusammengesetzten Ersatzvideodaten aus den verfügbaren Daten; und
adaptive Schaltermittel (66) zur Aufnahme der Videodaten aus der laufenden Zeile und den vorhergehenden und folgenden Zeilen sowie Abgabe eines Ausgangssignals unter Steuerung durch die Logikschaltung entweder der laufenden Zeile bei Fehlen eines Ausfalls oder der ausgewählten Ersatzdaten während des Auftretens des Ausfalls, wobei die zusammengesetzten Ersatzvideodaten eine Chromaphase besitzen, welche gleich der Chromaphase der fehlenden Daten ist.

10. System nach Anspruch 9, in dem die Videosignalverarbeitungsmittel einen Chromainverter (20) enthalten, der ein Chromabandpaßfilter (32) und einen ersten Normschalter (40) zur Aufnahme des Videosignals sowie zur Erzeugung eines Luminanzsignals und eines invertierten Chrominanzsignals enthält und in dem ein Normdecoder (100) an den Chromainverter und den ersten Normschalter und einen zweiten Normschalter (68) zur Steuerung der adaptiven Auswahl in Abhängigkeit von einer gewünschten Fernsehnorm angekoppelt ist.

11. System nach Anspruch 9 oder 10, in dem die Verarbeitungsmittel weiterhin eine Verzögerung zur Bereitstellung eines um eine Zeile in Bezug auf ein laufendes Videosignal verzögerten Videosignals und Mittel (70) zur räumlichen Mittelung des laufenden Videosignals und eines rückgeführten Signals aus der Datenschleife umfassen und in dem die Schaltermittel (66) in Abhängigkeit von der durch die Logikschaltung (76) durchgeführten adaptiven Auswahl selektiv ein Ausgangsvideosignal vom Chromainverter (20) liefern.

12. System nach den Ansprüchen 9 bis 11, **gekennzeichnet durch** Mittel (24) zur Erzeugung eines das Vorhandensein eines Ausfalls anzeigenden Auswahlimpulses und Mittel (74, 80) zur Abgabe von um eine bzw. zwei Zeilen verzögerten Ausgangsimpulsen und in der Logikschaltung (76) enthaltene Logikgatter, die zur Untersuchung drei aufeinanderfolgender Zeilen hinsichtlich des Vorhandenseins der Ausfallimpulse ausgebildet sind.

13. System nach Anspruch 11, in dem die Schaltermittel (66) zur Auswahl eines Ausgangssignals aus dem laufenden Videosignal, dem rückgeführten Videosignal und dem räumlich gemittelten Videosignal ausgebildet sind.

14. System nach Anspruch 9, **gekennzeichnet durch** einen Chromainverter (20); eine erste an den Chromainverter angekoppelte, um eine Zeile verzögernde Verzögerung (50); einen an den Chromainverter und die erste Verzögerung angekoppelten ersten Schalter (56); eine zweite, um eine Zeile verzögernde Verzögerung (60), welche die vom ersten Schalter auf den Chromainverter rückgekoppelte Datenrückführungsschleife definiert; und einen an den Chromainverter angekoppelten zweiten Schalter (68); wobei die adaptiven Schaltermittel (66) an die Ausgänge des Chromainverters des zweiten Schalters und der ersten Verzögerung angekoppelt sind.

15. System nach Anspruch 14 weiterhin enthaltend einen dritten Schalter (58), der den Chromainverter an den ersten Schalter (56) koppelt; sowie eine Normsteuerung (96-100) zur Zuführung eines Schaltersteuersignals an den ersten, den zweiten und den dritten Schalter.

16. System nach Anspruch 14 oder 15 weiterhin enthaltend Datenmittelungsmittel (64, 70), die an die ersten Verzögerungsmittel (50) und den zweiten Schalter (68) angekoppelt sowie zur Zuführung räumlich gemittelter Daten zu den adaptiven Schaltermitteln (66) ausgebildet sind.

Revendications

1. Système pour exécuter un procédé de remplacement automatique d'une perte de signal dans une ligne de données vidéo d'entrée constituées par des échantillons d'un signal de télévision couleur composite, qui comprend une composante de chrominance sous la forme d'un signal de sous-porteuse couleur modulé, par des données de remplacement qui sont prises d'une autre ligne ou d'une combinaison d'autres lignes du signal de télévision couleur composite, caractérisé par:

un décodeur de perte de signal (24) relié de façon à recevoir les données vidéo d'entrée et à produire une impulsion de perte de signal représentative de la présence d'une perte de signal dans les données vidéo;

des moyens logiques adaptatifs (26) reliés au décodeur de façon à ce que ladite ligne de données vidéo dans laquelle se produit la perte de signal et une multiplicité de lignes différentes, autres que ladite ligne de données vidéo dans laquelle se produit ladite perte de signal, sont examinées pour déctecter des pertes de signal;

des moyens de traitement de signaux vidéo (20) comprenant une multiplicité de trajets de signaux, un trajet comprenant un inverseur de signal de chrominance (32) et un autre trajet comprenant un circuit à retard (28) équivalent au circuit à retard de l'inverseur de signal de chrominance, les trajets s'étendant jusqu'à une boucle de recirculation de données (16) et également jusqu'à un commutateur adaptatif (66) au niveau duquel ladite multiplicité de lignes est rendue simultanément disponible en vue de la sélection de données issues de l'une desdites autres lignes ou d'une combinaison de celles-ci et les données de remplacement sont sélectionnées de façon adaptative en fonction dudit examen à partir des données qui sont rendues disponibles en vue de la sélection, les données rendues disponibles en vue de la sélection étant des données vidéo composites ayant une phase de signal de chrominance identique à celle des données manquantes qui sont représentées par la perte de signal; et

un commutateur (12) qui fournit les données vidéo d'entrée auxdits moyens de traitement vidéo (20) lorsqu'il n'y a pas de perte de signal dans les données vidéo d'entrée et qui fournit aux moyens de traitement vidéo un signal en provenance de la boucle de recirculation de données (16) lorsqu'il existe une perte de signal dans les données vidéo d'entrée.

2. Système selon la revendication 1, dans lequel les moyens de traitement de signaux vidéo (20) comprennent divers commutateurs, additionneurs et circuits à retard en aval de l'inverseur de telle manière que les données de remplacement sont sélectionnées à partir de données vidéo composites comprenant des données en provenance d'une ligne précédente, des données en provenance d'une ligne suivante, et des données représentant une moyenne établie spatialement en provenance de lignes précédant et suivant immédiatement la ligne dans laquelle ladite perte de signal se produit, et en fonction d'un quelconque format parmi une multiplicité de formats de télévision, les divers commutateurs situés en aval de l'inverseur de signal chromatique et le commutateur adaptatif étant reliés en vue d'être commandés par un décodeur

de format (100), si bien que les données présentées en vue de la sélection sont conformes à un format de télévision sélectionné.

3. Système selon la revendication 1 ou la revendication 2, dans lequel la sélection adaptative est représentée par des mots binaires qui commandent un moyen de commutation pour la sélection de données rendues simultanément disponibles à partir desdites lignes.

4. Système selon l'une quelconque des revendications 1 à 3, dans lequel la sélection est effectuée en fonction de la relation existant entre la perte de signal et des données situées verticalement dans des lignes adjacentes du signal vidéo.

5. Système pour remplacer une perte de signal dans une ligne d'un signal vidéo couleur composite d'entrée, par des données de remplacement issues d'une autre ligne ou d'autres lignes, caractérisé par:

des moyens de traitement de signaux vidéo (20) comprenant un inverseur de signal de chrominance (32) et des moyens (62, 64 , 68) servant à présenter, une vue d'une sélection, des données en provenance d'une ligne précédente, des données en provenance d'une ligne suivante et des données correspondant à une moyenne de lignes précédant et suivant la ligne dans laquelle se produit ladite perte de signal, lesdites données étant des données vidéo composites ayant une phase de signal de chrominance qui est identique à celle des données manquantes représentées par la perte de signal, lesdits moyens de traitement de signaux vidéo comprenant une boucle de recirculation de données pour fournir des données retardées et recirculées;

des moyens logiques adaptatifs (24, 26) pour recevoir le signal vidéo et pour déterminer l'étendue et l'emplacement de la perte de signal et les meilleures données de remplacement disponibles;

des moyens de commutation (66) qui, en réponse aux moyens logiques adaptatifs, sélectionnent, à partir desdites données rendues disponibles en vue d'une sélection, les meilleures données vidéo composites de remplacement disponibles qui sont appropriées à l'étendue et à l'emplacement de la perte de signal; et

un commutateur d'entrée (12) qui fournit le signal vidéo d'entrée auxdits moyens de traitement de signaux vidéo (20) lorsqu'il n'y a pas de perte de signal dans le signal vidéo d'entrée et qui fournit aux moyens de traitement de signaux vidéo des données retardées et recirculées en provenance de la boucle de recirculation lors d'une perte de signal dans le signal vidéo d'entrée.

6. Système selon la revendication 5, dans lequel les moyens logiques adaptatifs comprennent des moyens (24) servant à détecter la présence d'une perte de signal; et des moyens logiques de perte de signal (26) reliés aux moyens de détection pour générer des décisions de validation adaptatives sélectionnées qui correspondent à chacune des données de remplacement possibles.

7. Système selon la revendication 6, dans lequel les moyens logiques de perte de signal (26) comprennent des moyens pour générer des mots binaires représentatifs des décisions de validation adaptatives.

8. Système selon la revendication 7, dans lequel les moyens logiques de perte de signal (26) examinent simultanément une ligne vidéo courante et les lignes précédant et suivant immédiatement la ligne courante en réponse aux moyens de détection pour déterminer l'étendue et l'emplacement d'une perte de signal dans le signal vidéo.

9. Système de compensation de données manquantes représentées par une perte de signal dans une ligne de données vidéo, constituées par des échantillons de données d'un signal de télévision couleur composite, caractérisé par:

des moyens de traitement de signaux vidéo (20, 32, 28) servant à fournir, en rapport avec ladite ligne, des données en provenance d'une ligne précédente et d'une ligne suivante, et comprenant des moyens pour présenter simultanément une ligne courante des données vidéo comportant la perte de signal et des données vidéo composites en provenance des lignes précédente et suivante et comprenant une boucle de recirculation de données (16) pour renvoyer des données retardées et recirculées à l'entrée des moyens de traitement de signaux vidéo;

des moyens (24, 26) disposés de façon à examiner les données vidéo pour détecter des pertes de signal et comprenant un circuit logique (76) servant à effectuer une sélection adaptative des meilleures données vidéo composites de remplacement à partir des données disponibles; et

des moyens de commutation adaptatifs (66) pour recevoir les données vidéo en provenance de ladite ligne courante et desdites lignes précédente et suivante et pour transmettre à une sortie, sous la

commande dudit circuit logique, soit la ligne courante en l'absence d'une perte de signal, soit les données de remplacement sélectionnées lorsqu'il se produit une perte de signal, les données vidéo composites de remplacement ayant une phase de signal de chrominance qui est identique à celle des données manquantes.

10. Système selon la revendication 9, dans lequel les moyens de traitement de signaux vidéo comprennent un inverseur de signal de chrominance (20), comprenant un filtre passe-bande de signal de chrominance (32) et un premier commutateur de format (40), pour recevoir le signal vidéo et pour générer un signal de luminance et un signal de chrominance inversé; un décodeur de format (100) est relié fonctionnellement à l'inverseur de signal de chrominance et au premier commutateur de format et à un second commutateur de format (68) pour commander la sélection adaptative en fonction d'un format de télévision voulu.

11. Système selon la revendication 9 ou la revendication 10, dans lequel les moyens de traitement comprennent, en outre, un circuit à retard (50) servant à fournir un signal vidéo retardé d'une ligne par rapport à un signal vidéo courant, et des moyens (70) servant à établir spatialement la moyenne dudit signal vidéo courant et d'un signal vidéo recirculé en provenance de la boucle de données; et les moyens de commutation adaptatifs (66) sont disposés de façon à faire passer sélectivement un signal vidéo de sortie en provenance de l'inverseur de signal de chrominance (20) et des moyens d'établissement de moyenne (70) en fonction de la sélection adaptative effectuée par le circuit logique (76).

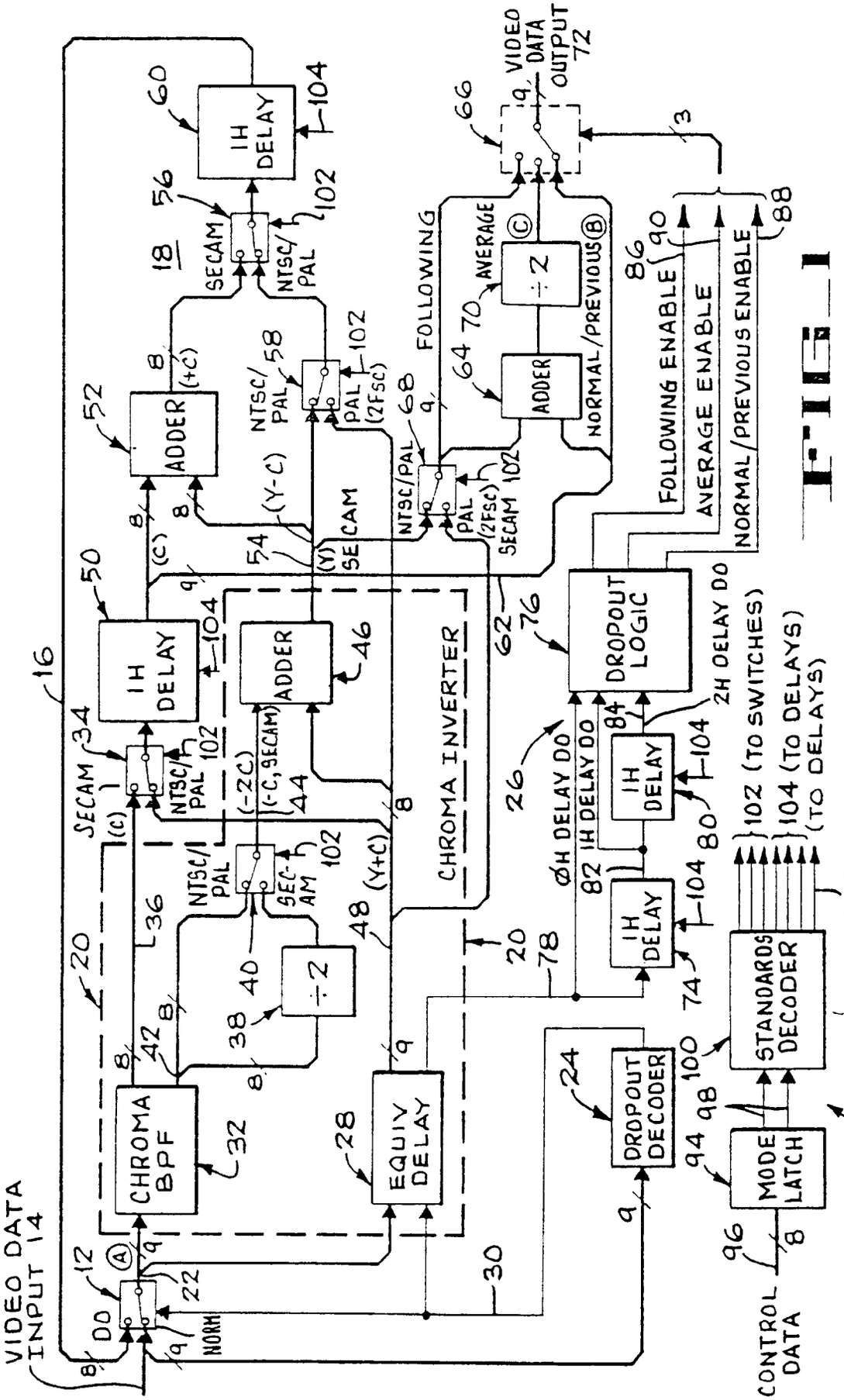
12. Système selon l'une quelconque des revendications 9 à 11, caractérisé par des moyens (24) pour générer une impulsion de perte de signal qui indique la présence d'une perte de signal, et des moyens (78, 80) pour fournir des impulsions de perte de signal retardées d'une ligne et de deux lignes, respectivement le circuit logique (76) comprenant des portes logiques disposées de façon à examiner trois lignes consécutives en vue de détecter la présence desdites impulsions de perte de signal.

13. Système selon la revendication 11, dans lequel les moyens de commutation (66) sont disposés de façon à sélectionner un signal de sortie à partir du signal vidéo courant, du signal vidéo recirculé et du signal vidéo représentant une moyenne établie spatialement.

14. Système selon la revendication 9 et caractérisé par un inverseur de signal de chrominance (20); un premier circuit à retard d'une ligne (50) relié à l'inverseur de signal de chrominance; un premier commutateur (56) relié fonctionnellement à l'inverseur de signal de chrominance et au premier circuit à retard; un second circuit à retard d'une ligne (60) définissant ladite boucle de recirculation de données reliée à partir du premier commutateur et revenant à l'inverseur de signal de chrominance; et un second commutateur (68) relié à l'inverseur de signal de chrominance; les moyens de commutation adaptatifs (66) étant reliés aux sorties de l'inverseur de signal de chrominance, du second commutateur et du premier circuit à retard.

15. Système selon la revendication 14, comprenant, en outre, un troisième commutateur (58) reliant l'inverseur de signal de chrominance au premier commutateur (56); et une commande de format (96 à 100) servant à fournir un signal de commande de commutateur auxdits premier, second et troisième commutateurs.

16. Système selon la revendication 14 ou la revendication 15, comprenant, en outre, des moyens d'établissement de moyenne de données (64, 70) reliés aux premiers moyens à retard (50) et au second commutateur (68) et disposés de façon à fournir aux moyens de commutation adaptatifs (66) des données représentant une moyenne établie spatialement.


VIDEO DATA INPUT 14
CONTROL DATA
VIDEO DATA OUTPUT 72
CHROMA BPF
EQUIV DELAY
DROPOUT DECODER
DROPOUT LOGIC
STANDARDS DECODER
MODE LATCH
CHROMA INVERTER
ADDER
1H DELAY
÷2
SECAM
NTSC/PAL
PAL (2FSC)
AVERAGE
FOLLOWING
NORMAL/PREVIOUS
FOLLOWING ENABLE
AVERAGE ENABLE
NORMAL/PREVIOUS ENABLE
2H DELAY DO
1H DELAY DO
ØH DELAY DO
102 (TO SWITCHES)
104 (TO DELAYS)
(TO DELAYS)

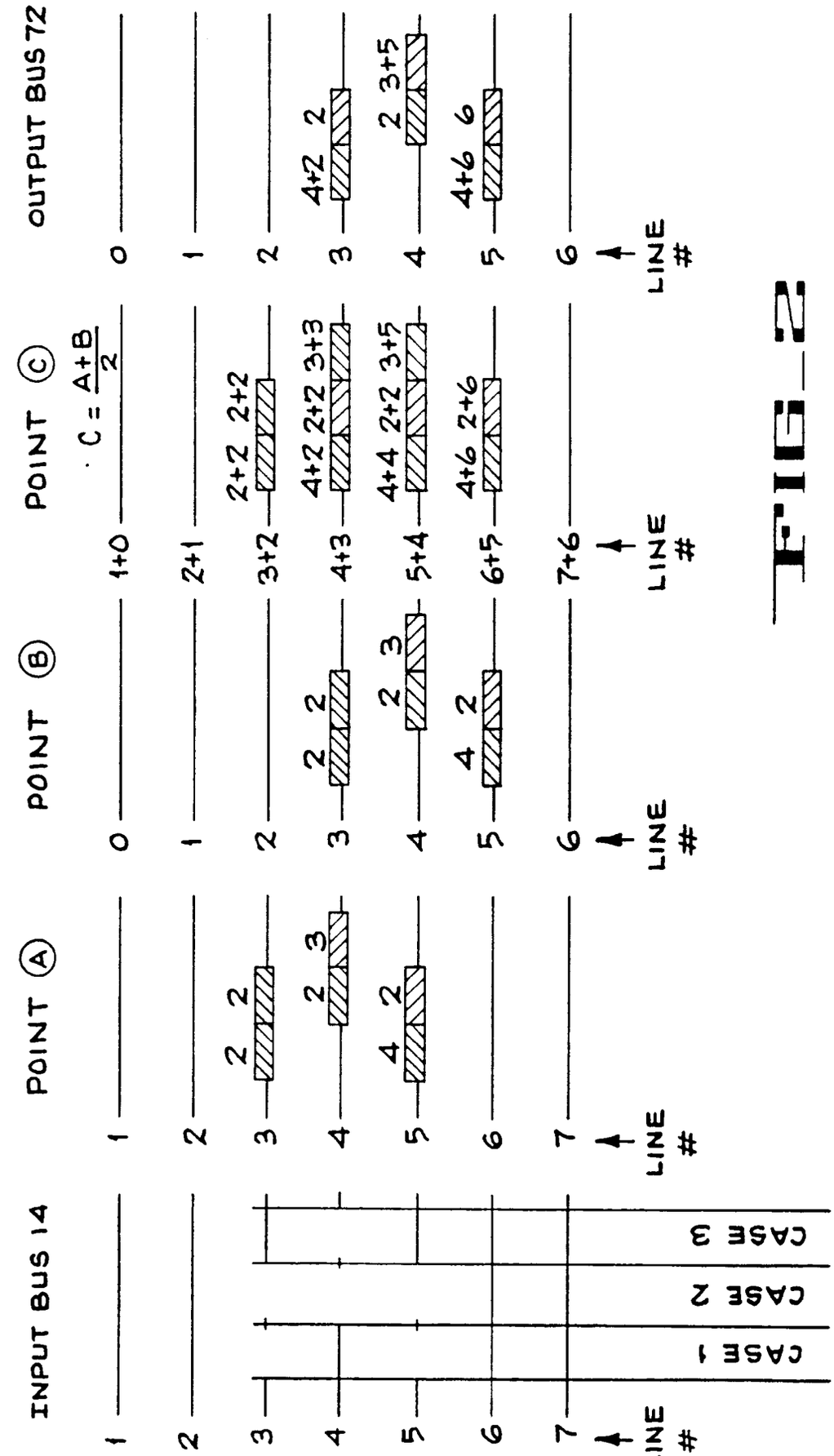

INPUT BUS 14
POINT Ⓐ
POINT Ⓑ
POINT Ⓒ
$C = \frac{A+B}{2}$
OUTPUT BUS 72
CASE 1
CASE 2
CASE 3
LINE #
LINE #
LINE #
LINE #
1
2
3
4
5
6
7
0
1
2
3
4
5
6
1+0
2+1
3+2
4+3
5+4
6+5
7+6
2 2
2 3
4 2
2+2 2+2
4+2 2+2 3+3
4+4 2+2 3+5
4+6 2+6
4+2 2
2 3+5
4+6 6

FIG_2

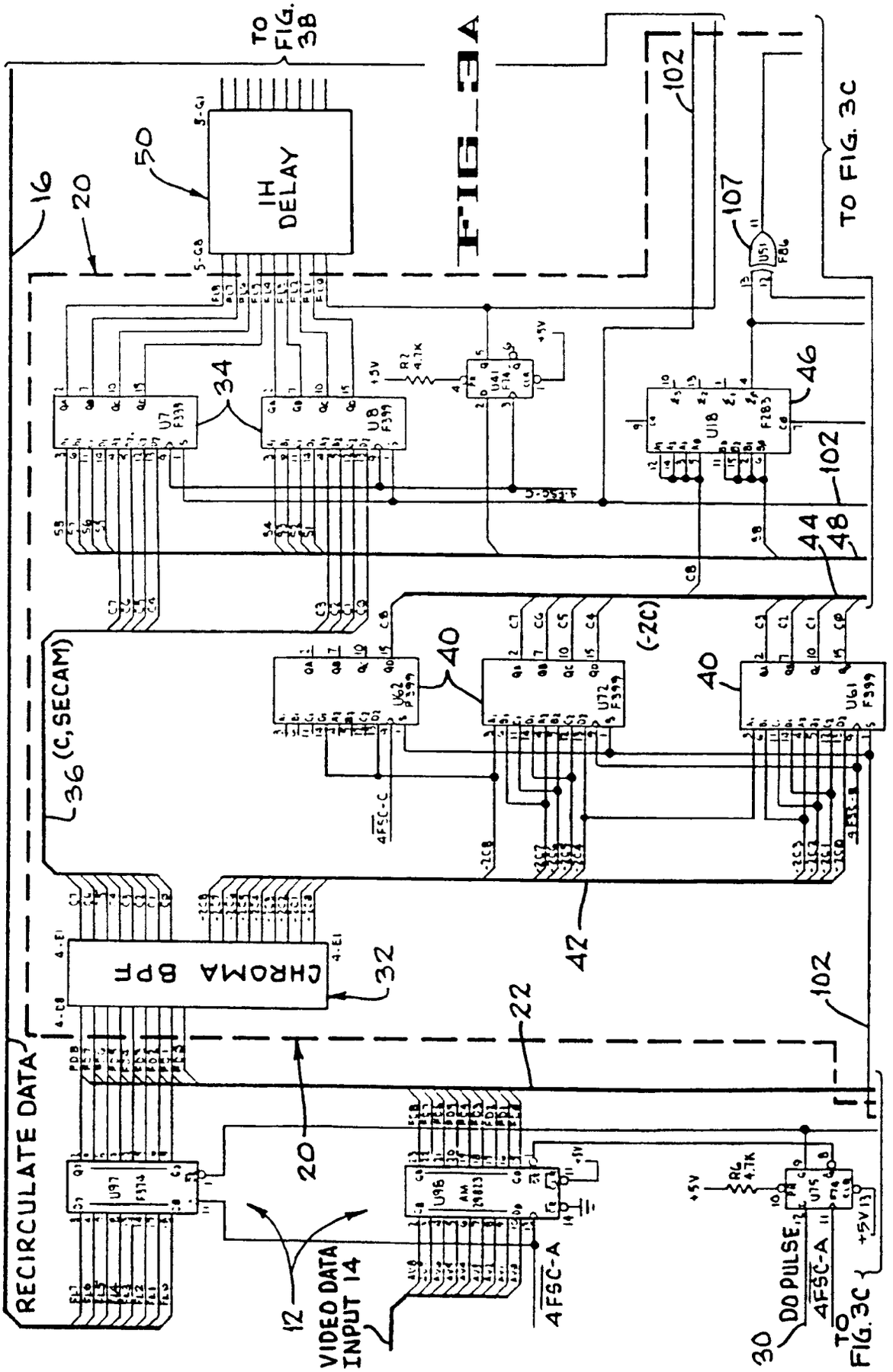


FIG. 3A
TO FIG. 3B
TO FIG. 3C
1H DELAY
50
16
20
102
107
34
46
44
48
40
36 (C, SECAM)
(-2C)
42
CHROMA BPF
32
22
RECIRCULATE DATA
VIDEO DATA INPUT 14
12
4FSC-A
DO PULSE
30
TO FIG. 3C

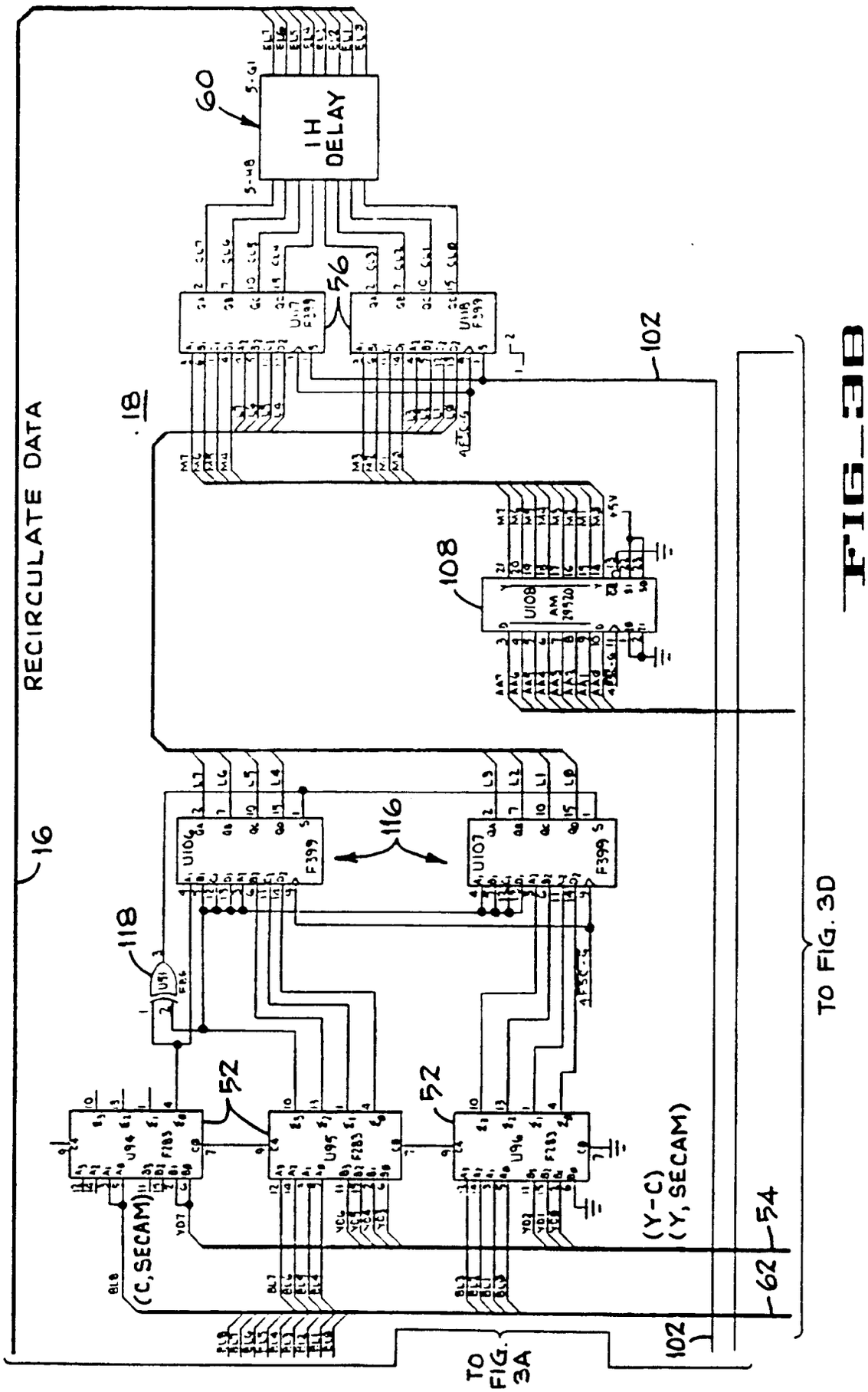

RECIRCULATE DATA
16
60
1H DELAY
56
18
102
108
U108 AM 29820
116
118
52
52
U104 F399
U107 F399
U94 F283
U95 F283
U96 F283
(C, SECAM)
(Y-C) (Y, SECAM)
54
62
102
TO FIG. 3A
TO FIG. 3D

FIG_3B

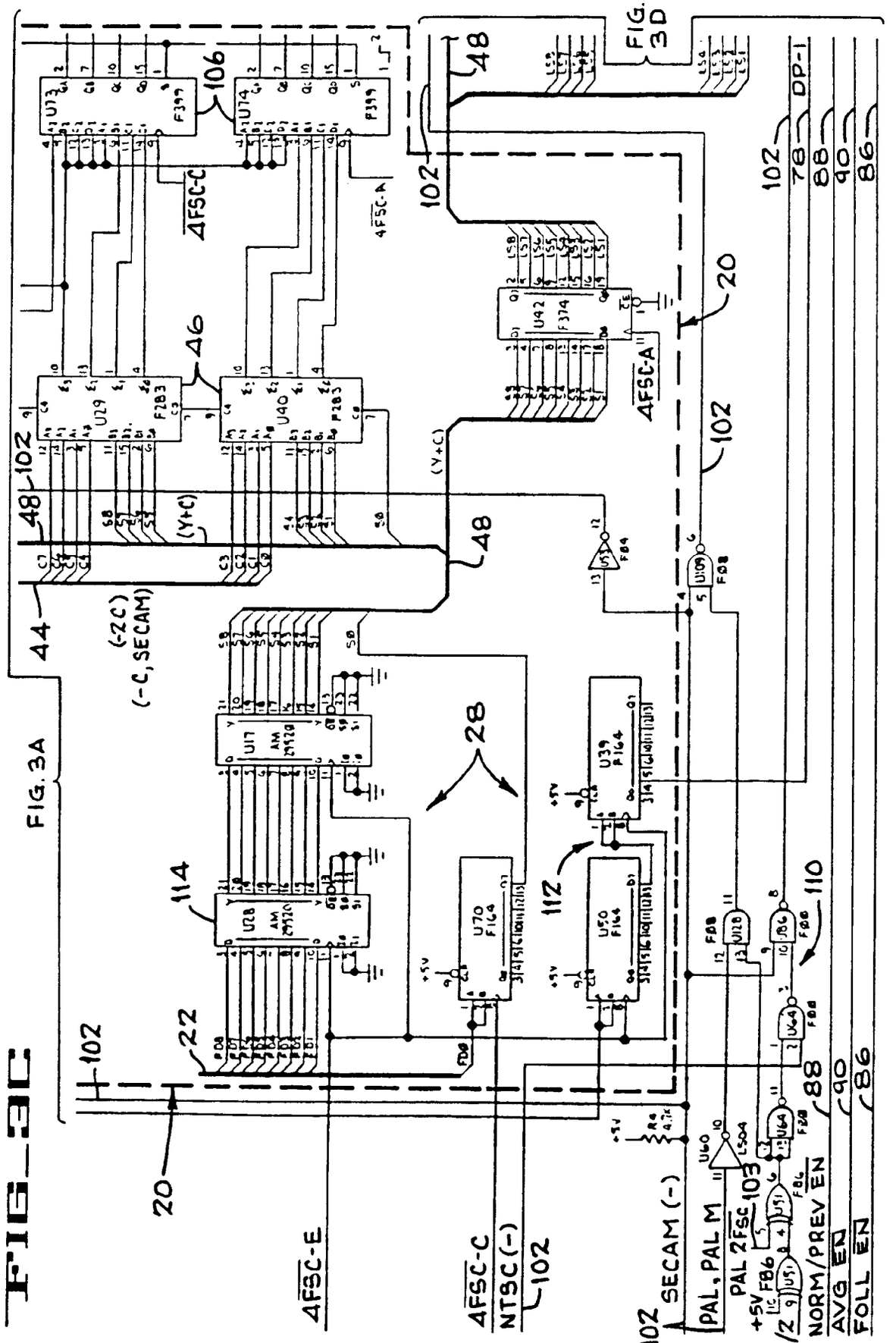


FIG. 3C
FIG. 3A
FIG. 3D
20
22
28
44
46
48
102
106
112
114
4FSC-E
4FSC-C
NTSC(-)
SECAM(-)
PAL, PAL M
PAL 2FSC
NORM/PREV EN
AVG EN
FOLL EN
(-C, SECAM)
(Y+C)
DP-1
78
88
90
86
110
103

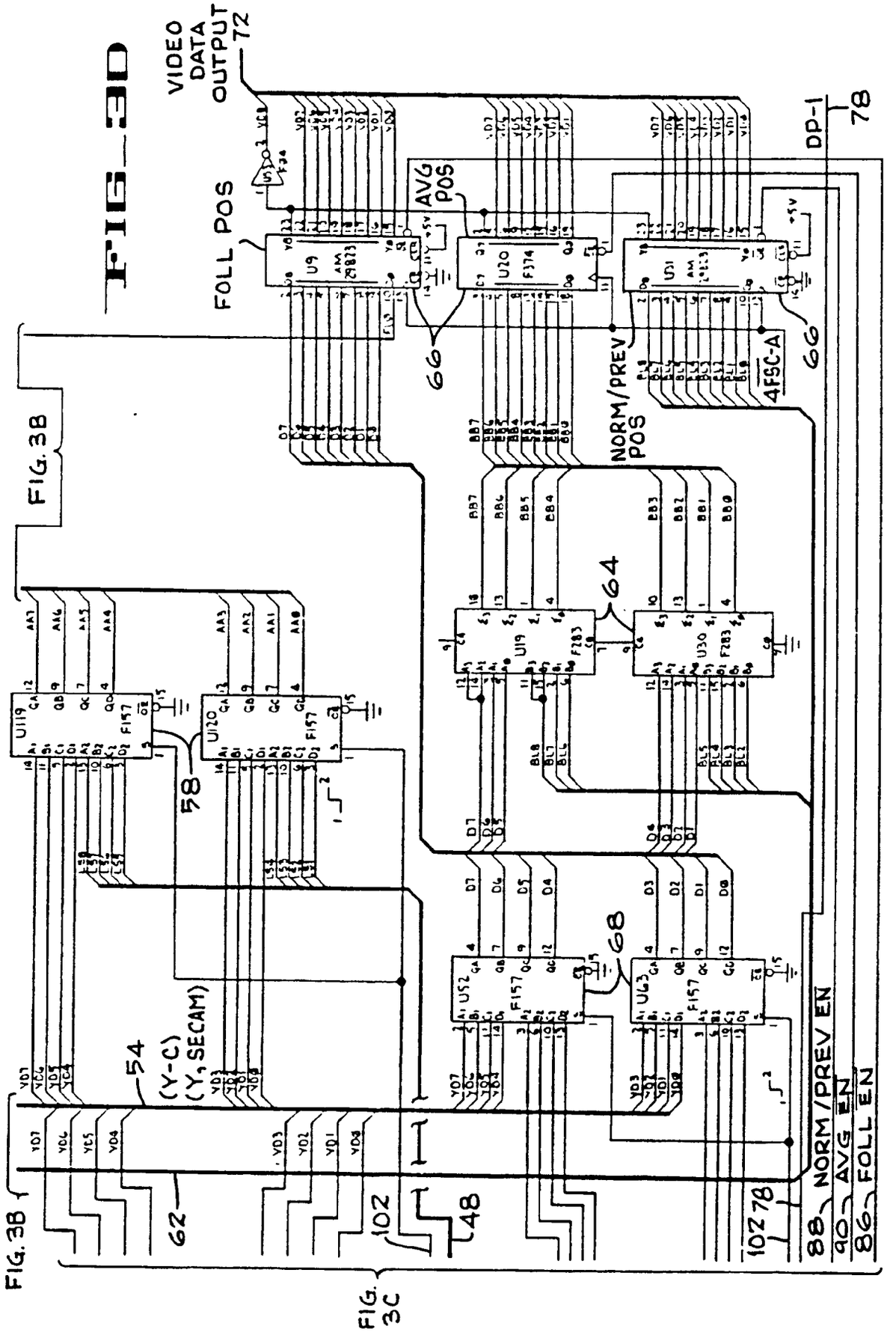


FIG_3D
VIDEO DATA OUTPUT
72
FOLL POS
AVG POS
NORM/PREV POS
4FSC-A
DP-1
78
66
64
68
58
54
(Y-C) (Y, SECAM)
62
102
48
88 NORM/PREV EN
90 AVG EN
86 FOLL EN
FIG. 3B
FIG. 3C

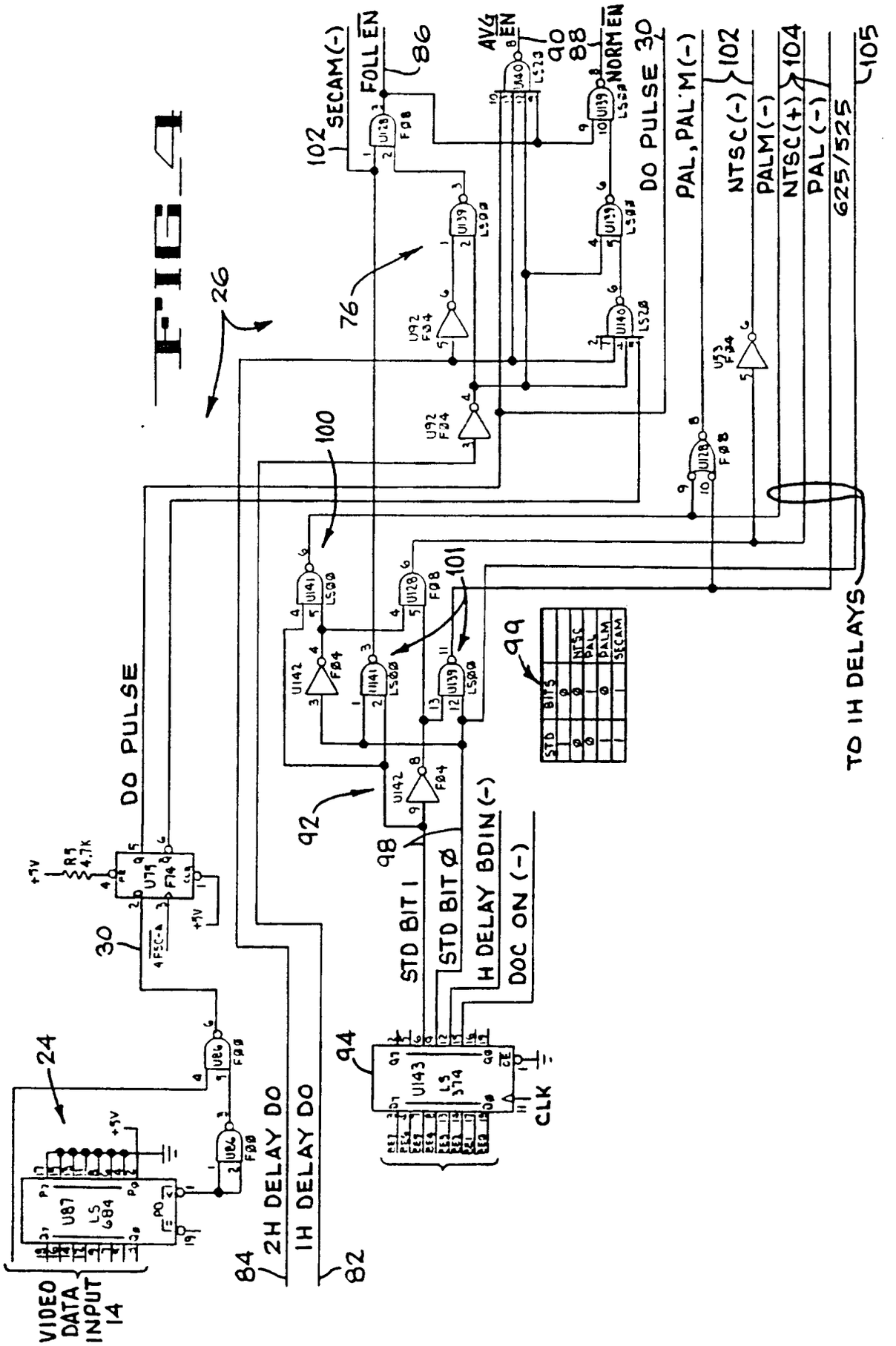


FIG 4
26
24
VIDEO DATA INPUT 14
U87 LS 684
+5V
U84 F08
2H DELAY DO
84
1H DELAY DO
82
30
4FSC-A
U79 F74
R5 4.7K
DO PULSE
100
U141 LS08
U142 F04
U141 LS08
U128 F08
101
U139 LS00
U142 F04
92
98
STD BIT 1
STD BIT Ø
H DELAY BDIN (-)
DOC ON (-)
94
U143 LS 374
CLK
99
STD BITS
NTSC
PAL
PALM
SECAM
76
U92 F34
U139 LS00
U92 F34
102
SECAM(-)
FOLL EN
86
U128 F08
AVG EN
90
88
NORM EN
U139 LS00
U140 LS20
DO PULSE 30
U93 F34
U128 F08
PAL, PAL'M(-)
102
NTSC(-)
PALM(-)
NTSC(+)
104
PAL(-)
625/525
105
TO 1H DELAYS